OPINION PAPER

The Footprint of an Earthquake

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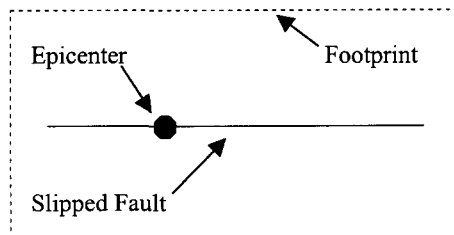
When the recent earthquake occurred in Turkey, it was generally known within a day where the epicenter was located and that the magnitude was M7.4. Many people asked me questions about the extent of damage and the loss of life that I could not answer because magnitude and epicenter do not provide sufficient information for engineers. For immediate engineering purposes one needs to know the approximate length, and the location and orientation of the fault slip (not the surface expression of the fault). The epicenter locates one point on the slipped length of fault, but this could be at either end or somewhere in the middle. In the case of the Turkey earthquake, the western end of the slipped length of fault seems to have been approximately 20 miles west of the epicenter, and the fault on which the slip occurred was essentially east-west trending. The locations of the ends of the slipped length of fault can usually be determined approximately by the clusters of aftershocks in their vicinities.

The length of slipped fault for an M7.4 earthquake would be about 60 miles, so the area subjected to strong shaking of 25% g or greater can thus be estimated to have had a length of about 70 miles and a width of about 40 miles, and this rectangle can be thought of as the strong motion footprint of the earthquake. The northwestern corner of the footprint was approximately 30 miles southeast of Istanbul, which explains why Istanbul was not more seriously damaged. Had the fault slip traveled farther west of the epicenter, the northern edge of the footprint would have passed 10 miles south of Istanbul, which would have caused much more damage. The foregoing discussion applies to strike-slip faults; other types of faults could have footprints of different shapes.

If, within a few days, the approximate location and dimensions of the footprint could be reported, it would be very helpful to outsiders in understanding the distribution of damage. The size of the footprint could be based on instrumental recordings and on insider observations of damage; and the width could be specified for 25% g or some lesser value as the situation requires. The slipped length L can be estimated from the Richter magnitude M, and if the location and orientation of the footprint can be estimated, many questions about damage and lack of damage could be answered. For a large earthquake the epicenter is not as helpful to engineers as is the footprint.

Approximate Locations

M	L
8.5	530
8.0	190
7.5	70
7.0	25
6.5	10



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